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Proceedings of the Maritimes Regional Science Advisory Process on the Assessment of Bay of Fundy Scallop

5 December 2007

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Dartmouth, Nova Scotia

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August 2008

Compte rendu de la réunion du Processus de consultation scientifique régional des Maritimes sur l'évaluation des stocks de pétoncle de la baie de Fundy

Le 5 décembre 2007

Institut océanographique de Bedford
Dartmouth (Nouvelle-Écosse)

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Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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SUMMARY

A Maritimes Regional Science Advisory Process was conducted on 5 December 2007 at the Bedford Institute of Oceanography in Nova Scotia to assess the status of Bay of Fundy scallop and provide management advice. Participation in this meeting included Fisheries and Oceans Canada (DFO), non-DFO scientists, Nova Scotia Department of Fisheries and Aquaculture, Aboriginal communities, and non-governmental organizations (NGOs).

SOMMAIRE

Une réunion s'est tenue dans le cadre du Processus de consultation scientifique régional des Maritimes le 5 décembre 2007 à l'Institut océanographique de Bedford, en Nouvelle Écosse, pour évaluer l'état des stocks de pétoncle de la baie de Fundy et formuler un avis sur leur gestion. Ont participé à cette réunion des membres du personnel de Pêches et Océans Canada (le MPO), des scientifiques de l'extérieur du MPO, ainsi que des représentants du ministère des Pêches et de l'Aquaculture de la Nouvelle-Écosse, de communautés autochtones et d'organisations non gouvernementales (ONG).

INTRODUCTION

T. Worcester, the meeting Chair, welcomed participants to the 2008 Bay of Fundy scallop assessment meeting and asked everyone to introduce themselves (Appendix 1). She provided a brief introduction to the meeting by describing the goals of the meeting, which were to conduct a scientific review of the information presented and then to develop fisheries advice based on this information. She reminded participants that management issues would not be addressed at this meeting. Participants were invited to participate fully in the discussion and contribute their knowledge and experience to the process. The reviewers, John Tremblay and Jae Choi, were introduced. The Terms of Reference for the meeting were reviewed (Appendix 2), including the objectives of this meeting, which were to:

For each of Scallop Production Areas (SPAs) 1, 3, 4, 5, and 6:

- Assess the status of scallop stocks by SPA, taking into account available commercial and survey information. In addition, the assessment model used in the Canadian Science Advisory Secretariat (CSAS) Research Document 2003/10 should be applied for SPAs 1A and 4.
- Evaluate bycatch of non-scallop species during the 2007 fishery.
- Evaluate the consequences of different harvest levels during the 2008 fishery on stock abundance and exploitation rate by SPA. For SPA 1B, these consequences should be provided for subareas Scallop Fishing Areas (SFAs) 28C, 28D, and the rest of SPA 1B (SFA 28B minus SPA 6).

The Agenda (Appendix 3) was reviewed, and nothing further was added. The possibility of ending the meeting early was discussed. It was agreed that efforts would be made to finish the meeting in 1 day rather than the 2 days originally scheduled.

REVIEW OF THE STATUS OF BAY OF FUNDY SCALLOP

Smith, S.J., S. Rowe, and M. Lundy. 2007. Scallop Production Areas in the Bay of Fundy: Stock Status for 2007 and Forecast for 2008. RAP Working Paper 2007/035.

Presenter: S. Smith
Rapporteur: T. Worcester

Introduction

Presentation Highlights

Advice on SPAs 1A, 1B, 3, and 4 are now based on a delay-difference model. The number of survey tows is currently high relative to surveys prior to 2006, but this level of survey coverage may not be sustainable given uncertainties in ongoing availability of DFO resources. The delay-difference model is quite simple and tracks changes rather than explaining them. A state-space formulation was used with process and observation errors. Minimum stock size and maximum exploitation rate were discussed as potential reference points. Bay of Fundy scallop biomass have never been low enough to prevent recovery, so minimum stock size is not known. However, in the past, biomass has almost always increased with an exploitation rate less than 0.2.

Questions of Clarification

A question was asked about how shell height and meat weights are derived. Shell heights and meat weights are measured during the annual surveys. Conversion of numbers caught in the survey to weight is done by using a model which incorporates depth into the shell height/meat weight relationship. Annual trends in meat weight are presented using the average meat weight for animals with 100 mm shell height.

Someone asked whether it would be easy to compare the table for SPA 1A (the decision table to evaluate catch levels with respect to posterior probability of exceeding an exploitation rate of 0.2) in this year's Science Advisory Report (SAR) to last year's SAR. The response was that it would be difficult because the current year used all 3 survey areas in 1A and the actual catch, while last year only one survey was used with the proposed Total Allowable Catch (TAC).

Review of Working Paper

New sections in the working paper were appreciated, and the assessment was felt to be of high quality. The decision rules were thought to be presented in a way that, while not entirely unique, was uncommon, and they were expected to be useful.

Application of the model across the whole area (as opposed to each individual area) was suggested. Alternatively, the best estimates from the various areas could be applied to the whole area. The SPAs have been assessed separately since this is the way that the advice has been requested by Fisheries and Aquaculture Management (FAM).

There was some discussion about whether the areas within the Bay of Fundy are separate biological units. By the time scallops reach 3 years, their biomass and growth is region specific.

There was some discussion on the growth rates used in the delay difference model, including how area specific these were. It was explained that where data was available, a spatial growth model was used. In other areas (SPAs 1A and 1B), an average model was used. Area specific growth models for these areas will be available next year. Additional questions included whether there were any seasonal dynamics in meat weights, and whether it was felt that the dynamics were being modeled appropriately. It was noted that surveys are done at the same time every year, so change in weights from survey samples can be evaluated over the survey time but not for the whole year, i.e., survey weights are point to point. Meat weights from the commercial fishery may provide a better indication of changes over a broader time frame, and investigations are underway to determine how these might be used in the future.

Use of pre-recruits (i.e., scallops that will recruit to fishery in two or more years) as an additional parameter was suggested; however, catchability of pre-recruits is difficult to nail down and can vary across regions and time.

It was asked whether temperature or substrate had been considered as covariates in addition to depth. The response was that correlation with temperature and substrate had been evaluated where the information was available, but was not found to be significant for temperature. Some significance was observed for substrate, but there is not a lot of information available on substrate at present. There should be more information available in the future. Substrate is used in SFA 29.

Concern was expressed about including biomass in both x axis and y axis of Figure 6 of the working paper, which could lead to spurious correlation. It was suggested that a yield per recruit

analysis has the same issue. An alternative suggestion was to plot absolute growth against mortality. It was noted that a good growth model is required to do this. In general, Figure 6 shows a good relationship between exploitation rate and percent change in biomass, but the scatter is quite large. If the model fits are as good as they appear, an assessment may not be needed every year. Every other year may be acceptable. Given that the assessment is based on this, additional investigation was recommended.

The important of reference points was stressed. A question was asked about why SPA 1A used an exploitation rate reference (F_{ref}) of 0.2 instead of 0.12 (as suggested from Figure 6). The response was that Figure 6 is based on this year's model results. At present, SPA 1A appears to have low productivity, but it has had higher productivity in the past. It is hard to apply an average productivity when it is episodic. In order to ensure some stability and avoid using a different reference point every year, a F_{ref} of 0.2 is used as an upper bound. It was felt that using 0.2 as the steady state decision rule outside of extreme events made sense, but it would be dependent on when it was first applied, i.e., first applied in a high or low period. Since the minimum stock size is not known, it not known at what biomass level the stock would be impaired, and episodic recruitment sometimes occurs at low stock levels. This was recognized as an important issue worth further consideration.

A question was asked about the historical distribution of scallops in the Bay of Fundy. It was noted that the state-space approach is fundamental to the assessment. This approach assumes that population dynamics are bounded by the observations, which are forced by the abundance indices. The implications of increasingly extreme conditions over time were discussed. It was noted that current conditions are already pretty extreme.

The movement of scallops was discussed. The assumption of no movement after three years was questioned. While small-scale movements do occur, it is assumed that large scale movement between areas is limited based on tagging studies and literature. No local research has been conducted on this. Reports of scallop group movement in shoal water were raised. It was suggested that groups of scallops could move a few hundred meters and be missed by dragging. It was noted that even the surveys have difficulty going back to exactly the same spot. It was asked whether bad storm could move scallops, and whether mark-recapture studies were conducted in areas of high tidal flow. The response was that mark-recapture studies were conducted in a wide range of habitats, and they did not show huge movements. If you follow the survey series, you can see groups of scallops persisting over time within a range of hundreds of meters.

It was asked whether there is a way for the model to incorporate the impact of storms or potential damage by gear. The response was that it could if these things resulted in detectable changes, like a mass mortality event that creates clappers. If an event does not create clappers, immediate impacts are difficult to detect. It was suggested that incidental mortality could be investigated further, but it has not been looked at in many areas. It was noted that the clapper model has an informative prior on the time it takes the clapper hinge to fall apart based upon laboratory studies reported in the literature.

It was suggested that it would be useful to present the parameter estimates from the model runs during the assessment meeting, as it would be interesting to see differences across areas. The response was that the working paper is already over 100 pages, and it is difficult to predict what a given reviewer will want to see.

SPA 4

Presentation Highlights

SPA 4 is now into a low period. There is a small amount of recruitment, which will be important in 2009. The closed area for pre-recruits needs to be evaluated for next year's fishery. The model fits well to biomass estimates in general, except during a mass mortality event. Predictions work well, except for years of high recruitment when growth might have changed. Exploitation rates are quite similar to last year's predictions. This area is currently depending on growth for removals. Catch of 100 mt should result in exploitation rate of less than 0.2. Biomass is expected to increase by 8%, if meat weights stay the same.

Review of Working Paper

If one accepts the assessment approach, then the results looks good.

The characteristics of a standard tow were clarified. A standard tow of 8 minutes is used, and the tow area is calculated. The tow is not started until the gear is on the bottom (can feel it). Actual distance towed is tracked by recording location points every 2 seconds. It was noted that snow crab tow distances often vary with depth, and the actual distance on the bottom can be different than what is calculated.

The scallop survey station densities are quite high (order of magnitude). It was asked whether station density had been explored to determine optimal fits of data. The response was that this has been investigated and, given the patchiness of scallops, the stations densities are considered to be appropriate for the resources currently available.

A question was raised about the rationale for the analysis of commercial meat weights. The assessment team suggested that they could sometimes see evidence of recruitment through meat weight sampling, but this would be something worth discussing further at the end of the meeting.

There is some evidence of lack of fit during some years. It was asked whether this is assumed to be a result of catchability issues or growth. The response was that both were likely. It was felt to be an adequate fit, but there are some issues with catchability. It was suggested that an objective measure for fit to compare against areas would be helpful.

In the past, the commercial catch rate has not been included in the assessment model and people have asked why. This year, deviance information criteria (DIC) was used to evaluate the inclusion of commercial catch rate along with survey indices of commercial size scallops. The results of this evaluation indicated that commercial catch rate did not add to the information on population trends already contributed by the survey indices and, therefore, did not need to be included in the model.

Someone asked whether the survey is redundant, and if commercial catches could be used instead. It was noted that the survey provide some additional information, such as shell heights and clappers. The commercial vessels do not use a liner, which provides samples for recruitment indices.

SPA 1A

Presentation Highlights

SPA 1A has only been in existence as a separate area since 2002. The TAC last year was 150 mt. Meat weight has increased in this area. Catch rates are up slightly, but this area is still in a low period. It appears as though there could be a 2006 year-class on Georges Bank (strong in SPA 3) and in other areas (pre-recruits in the 8 to 16 Digby area), which may be extensive. This is the first year that the previously described assessment approach has been used in this area. In general, the model appears to be stable and good at predicting the past. Its one year projection is slightly optimistic. An increase in the TAC to 150 mt would still be likely to achieve an exploitation rate of 0.2. At this TAC, no change in biomass would be expected as long as meat weight remains high.

Questions of Clarification

A question was asked about the standard error for the graphs. The response was that the standard error was not large, but it was not displayed.

It was clarified that the increase in meat weight is only relative to 2006 and not to the long-term average.

There was some discussion about what might be causing the trends in meat weight. It was suggested that it may be related to productivity. 2000 was a high productivity year, but there are no strong correlations between ocean color and diatoms (main prey). It may also be condition and production related. Some areas are close to shore and may be influenced by nutrients, which complicates things.

Some further clarification was requested on the decision table. It was explained that a couple of things change from year to year. The current year's assessment has the actual landings of the previous year rather than predicted landings. It also uses additional survey information and the previous year's actual meat weights. With all this new information, the assessment for this year is more optimistic than last year's prediction. However, it should be noted that this year's assessment may be overly optimistic if the meat weights change. Suggestions for leveling this out may be required.

It was suggested that, depending on exploitation rate, meat weights could be declining as a function of fishing. Fishers go where densities are highest, where scallops are young. It was suggested that meat weights may have decreased over the time frame of the fishery, which needs to be investigated.

The tight fit of the model was a concern to one reviewer. It was suggested that the model may be fitting too tightly to the survey information and may be rejecting other sources of information. However, it may also be good fit because of the sampling densities. It was asked whether an aerial expansion had been compared to the model estimates, i.e., the survey index (biomass and numbers) could be converted to per meters squared and extracted to total surface area. It was noted that the model was already area-based. Survey estimates that go into the model starts off as mean number per tow, which is then transformed into kg/tow, which is then expanded to the areas of the survey.

Review of Working Paper

It was asked whether it would be possible to add error into the catch. The response was that there was nothing to base the error on at present.

It was clarified that SPA 1A goes right to shore, and that there are some areas that are closed for a very short time. In previous years, there has been minimal fishing inshore. Fishing patterns have not changed significantly.

Maps of the previous year's survey catch indicate that coverage has increased over time. It is very helpful to see these changes, as done for SPA 3.

It was noted that the working paper does not stress how this assessment is more optimistic than last year's because of these 2 things – meat weights and including all of the surveys in the area. The number of stations within a survey polygon has changed over time, though it is still a stratified random design. The stratification had been based on commercial catch rates in the 8-16 mile zone until 1989, when it was changed to the current design.

The rate at which pre-recruits become recruits to commercial sizes depends on growth. However, there is a minimum of 2 years between pre-recruits and commercial sizes. The assessment team has explored measuring ages from shells, to build up information on age composition and improve growth information. It is unclear why recruitment pulses seem to disappear in SPA 3, as it is not well measured.

In an ecosystem approach to management, an understanding of prey species (diatoms in this case) and other ecosystem interactions are important. It was asked whether there was information on diatoms, chlorophyll, potential predators, or temperature for this area. The response was that good indices of diatoms had not been found, that chlorophyll information could not be obtained in time for this assessment, and temperature information had been difficult to present in a useful manner. The Bay of Fundy was not thought to be well sampled by oceanographers. It was also noted that the working paper is already quite large.

Someone asked what the dominant predator of scallops was. The response was that starfish are a dominant predator of scallops, but they were not well monitored (not counted in the survey). Efforts have been made to expand bycatch information from fisheries and surveys. Major groundfish species has been monitored in the survey since 2001. Lobsters have always been counted in the survey, but bycatch rates are small. There is no observer coverage of the Bay of Fundy scallop fishery.

SPA 1B

Presentation Highlights

This is the first year that modeling has been used for this area, and only survey data from 1997 was used. The TAC last year was 400 mt. Catch rates increased slightly after 4 years of decline for Full Bay and Mid Bay fleets, but there has not been much change in the catch rate of the Upper Bay fleet. Recruitment pulses appears to be coming through the population. Pre-recruits are declining and recruits are increasing now. Some commercial meat weight to shell height sampling was conducted, and it looked better in winter 2006 than previously, and 2007 looks better than 2006. The model fit the data well, but it showed a bit more variability than the projections for the other areas. The constant growth model seems to be influenced by increasing meat weights, which affects back projections and predictions. A catch of 400 mt

would be likely to achieve a 0.2 exploitation rate with a 9% increase in biomass (if meat weights continue to be high.

Questions of Clarification

It was asked whether the reference for this area should be an exploitation rate of 0.2 or a constant biomass. The response was that this was open for discussion.

Review of Working Paper

It was noted that the meat weights in Table 3 appear higher. It was explained that this was based on a small number of samples. Meat weights were higher for Full Bay and similar to 2006 for the other fleets.

There was some discussion of scallop condition in this area. It was suggested that some fishers are seeing better condition animals than last year, which was confirmed by observations from meeting participants and observations provided in the assessment.

There was also some discussion of bycatch. It was noted that the bycatch in the surveys is similar to other areas, including rocks. The most abundant fish bycatch species are monkfish and flounders. In certain areas, starfish are abundant. It was noted that when video work has been done off Digby, scallops are not observed in locations where there are lots of starfish.

Changes have been observed in benthic species composition over time in the Bay of Fundy. Natural Resources Canada and the Canadian Hydrographic service are conducting multibeam surveys of the Bay of Fundy, which should be complete by the end of 2008. These surveys will provided additional information on fine scale bathymetry, geomorphology and contribute to a better understand of benthic habitat.

Fisheries representatives asked about Marine Stewardship Council (MSC) certification. It was suggested that the fishery would be in a good position to work through this process, and having decision rules would help. It was noted, however, that MSC certification is a lot of work. Bycatch is considered to be very small in this fishery, and it would be important to document this. Fishers had been allowed to land monkfish, so this would be in the log books.

SPA 3

Presentation Highlights

SPA 3 has a TAC of 200 mt, which was not caught completely. Catch rates have declined since 2003. Effort has declined due to redirection to SFA 29. There has been an increase in meat weights from 2006. The survey design has been stable since 1996.

This year's assessment is based on the results of a delay-difference model, as problems with the model appear to have been fixed and it is only about 10% off with predictions and back calculations. At 100 mt, there is a higher probability of exceeding an exploitation rate of 0.2, and a decrease in biomass is expected for all TACs evaluated (50, 100, etc.). However, recruitment looks more promising this year, and recruits appear to be plentiful in shallower water where survival may be better than in the deeper areas. Recruitment could enter the fishery in 2009/2010. A reduction in fishing mortality on smaller scallops would help to protect future recruitment in this area.

Questions of Clarification

It was asked why the model fit this year and not last year. The response was that it is important to line the survey up with the fishery. Prior to 2004, the survey was after the main part of the fishery. Since 2004 the survey precedes the major part of the survey. The current model takes this change in timing into account.

Clarification was requested on the use of repeated station surveys. It was explained that repeating stations from last year in this year's survey is used to develop a correlation coefficient, station by station. This is a very old methodology. Guidance is available in the literature to ensure a good balance between new stations and old stations. It is still a work in progress. This approach is described in more detail in last year's Research Document (Smith et al. 2007).

There was some discussion about what happens to pre-recruits, i.e., why do they not always appear in the fishery. It was suggested that when recruitment occurs in deep water, it tends to be in marginal habitat and the pre-recruits may not survive.

A request was made that variance be included in graphs of change in meat weights over time.

Someone asked why the TAC was not caught. It was explained that there was better fishing other places. If there is a choice between fishing 10 miles from shore and 30 miles from shore, fishing will generally been closer to minimize fuel costs. Not everyone in the fishery experienced low catch rates.

Review of Working Paper

It was asked why the DIC for this area seem to be smaller than for other areas. It was suggested that DIC cannot really be compared across datasets.

The use of a linear model for repeated survey estimate was questioned. It was suggested by a reviewer that using a lognormal response might give better performance. However, the assessment team felt that conversion to a different scale did not help much and would likely be more trouble than beneficial.

Apparent changes in the catchability of small scallops were questioned. It was explained that as gear gets clogged, this may affect the catchability of other sizes.

Someone asked whether the repeated survey design would continue to be used. The response was that this still needed to be determined.

SPA 6

Presentation Highlights

SPA 6 had a TAC of 140 in 2007, and the catch to 26 November had been 68 mt. There had been little change in the catch rate in SPA 6A and 6B, but there had been a decline in catch rate in SPA 6C. The management lines in this area are currently being reviewed, and Campobello may be moved into SPA 6C. A repeated survey design was used to increase precision, resulting in an increase of about 10% over that from a completely random survey design. Survey estimates of abundance and biomass show a decline in the SPA 6C area but no decline in other areas. Most of what is going on is because of Duck Island Sound. There is no abundance increase in SPAs 6A and 6B; therefore, there is no reason to change the TAC for these areas.

Review of Working Paper

A request was made that variance be included in graphs of change in meat weights over time and a better description of average meat weights (not just increase from 2006) be provided to describe the longer-term trend.

It was suggested that this might not be a good survey design for this area, as it seems clumped, and a question was asked about the selection of survey locations. The response was that there was an attempt to select stations randomly in SPAs 6B and 6A, but there was limited coverage in 6C and in Maces Bay. It was felt that this is one area where a discussion would be useful on the level of sampling versus standard error. It was asked whether a 30-60% change in population could be detected based on tow estimates.

It was asked whether logbooks are geo-referenced. The response was that one location was required per day as long as a vessel stayed within 5 miles. However, vessels can move a lot. The Vessel Monitoring System (VMS) is polling once an hour, so it is difficult to determine exactly where fishing is occurring. It is possible to match the VMS record with the logbook records, but this takes time. Efforts are underway to find software to make this easier. At present, VMS is mostly being used to check if there is a problem. Eventually VMS might collect a continuous track, and then it might be more useful.

It was suggested that more of variance of the repeated survey estimate might be absorbed if a mixed effects model was used. Some discussion ensued on whether or not all the stations should be repeated from year to year. It was noted that this assessment is not currently based on a model. Sampling has been spotty and scallops have been patchy. The area is more complex and estimating available area would be difficult. Now that models seem to be working in other areas, it might be worthwhile investigating a model for this area.

The issue of whether this was a separate biological unit was raised. The area does seem to be experiencing the same trend in meat weight as other areas.

Someone asked whether surveys in the Maces Bay area were planned. It was noted that Dale Roddick (DFO Maritimes Science) had tried this and was not very successful. Others have also tried, but they have experienced problem with mud, and a faster towing speed is needed. It is possible that surveys could be done with different gear and a different approach. To date, efforts to conduct a survey in this area have not been successful.

SPA 5

Presentation Highlights

SPA 5 had a TAC of 10 mt in 2007, with a catch of 3.8 mt. Catch rates have declined since 2003. Growth rates are a bit faster here. No model has been fit for this area. The intent is to keep catch rates at their average, i.e., catch rates should not exceed the average from 1997–2007, excluding 2004. In order to achieve this, the TAC should not exceed 10 mt.

Questions of Clarification

It was suggested that this seems like a small area to provide advice for, and it was asked whether it could be grouped in with SPA 4. It was noted that this management area is defined in regulations. It has a short season and a small area.

It was asked whether SPA 5 is considered to be a separate biological unit. It was suggested that this may be more separate than other areas.

Other Discussion

Someone asked what the advantage of having a number of small management areas was. The response was that it helped to determine fishing impact on local abundance there and enabled catch to be evaluated by area. It was suggested that the management lines could be kept for reporting purposes, but fishers could be allowed to fish anywhere. It was noted that different TACs in different areas were used to even out exploitation rates. If there was a single TAC for the whole area, it would be up to fishers to distribute effort appropriately. It was suggested that fishers would not fish an area out, since it would not be economical to do so. It was noted that the fishery had not changed since the introduction of individual transferable quotas (ITQs). It would be important to know where catches are occurring. It might be hard the first couple of years, but it would mean that advice would not have to be provided for all the different areas. It was suggested that maybe now the model was working, this question could be explored.

RESEARCH RECOMMENDATIONS

The following areas of research were discussed:

- Use meat sampling from commercial catch as an indicator based on expectations from the model or to derive numbers landed to express exploitation in terms of numbers (convert catch weight to catch numbers and population biomass to population numbers).
- Investigate a more appropriate survey design for Maces Bay).
- Develop growth models for all areas (requires more ageing).

It was suggested that a spatial representation of catch rates could be investigated, though the usefulness of this exercise was uncertain. Information from the catch database would first need to be cleaned up (i.e., address catches reported on land). A spatial model of the distribution of scallop abundance could then be compared to catch rates to get spatially explicit exploitation rates. The area could be gridded, and the model could be run for each square. This is the approach taken for snow crab (1 km resolution). Results may be useful for industry, as this could enable redirection of effort from areas where the exploitation rate is high. Areas of low catch rates could also be identified. In the snow crab fishery, 5–10% observer coverage is used to support the approach of near-real time monitoring at a course scale. For the snow crab fishery, this is used to avoid areas of soft shell. For the scallop fishery, it may useful to monitor areas of recruits.

It was asked how scientifically-based areas of closures for small scallops could be established. It was suggested that DFO Science could provide the information, and consultations with industry could be conducted to get agreement. Survey information could be conveyed to industry in September. This may not be possible for all areas given existing resources. In the offshore, some areas were closed and catch rates were doubled the next year. The U.S. uses rotational closed areas. It was suggested that Area 3 might benefit from this approach.

A question was asked about what criteria would be used to open areas again once they had been closed voluntarily by industry. Area 29 was used as an example. The response was been that the industry is free to recommend opening as they see fit, and DFO Science will endeavor to provide the information industry needs to make such as decision.

It was whether it would be possible to keep an area open if the TAC had been reached but catch rates were still high. It was suggested that there may be opportunities to look at small area management but that the current annual stock assessment process is not conducive to this approach. It was also suggested that observers may be required. It was noted that fuel costs are now a major consideration in the economic sustainability of the fishery.

REVIEW OF SCIENCE ADVISORY REPORT

Context

- Upper Bay is part of the Bay of Fundy. List the 3 fleets that fish this area.
- Move the second paragraph into the biology section.
- Add "conducted as an annual assessment based on a framework conducted in 2002."

Summary

- SPA 1A: not "drastically".
- SPA 2 is included in the SAR even though it was not assessed this year since we often receive questions about it. Mention that it was last assessed in 2006.
- It was clarified that effort is not mentioned to decrease amount of graphs and text.
- Interim of 50 was for October only in SPA 3.
- The bullet for SPA 3 is not as clear as other bullets.
- All other areas use an exploitation rate of 0.2.
- SPA 3: Catches of less than or equal to 50 mt in 2007/2008 are expected to result in exploitation rates less than 0.2; however, declines of 9% in biomass are expected at this level.
- Scallops 10-40 mm seem to be fairly widespread and measures to enhance protection of this size-class should be considered.
- Better estimates of the strength of this year-class should be available from the 2008 survey. Do not include the rest of the sentence.
- All SPAs: Statement on meat weights is relevant to all area.
- Missing population biomass estimates in SPAs 1A and 1B. List population biomass, with below average over past 10 years.
- SPA 4: This is the first reference to "TAC", and it should be in reference to target exploitation rate. Be consistent in each bullet.

Background

- Add biology from context (second paragraph).
- Rationale for Assessment: Move bycatch, "Survey Coverage", and "Changes in Meat Yield" into an "All SPAs" section at the front.

All SPAs

- Include bycatch, etc. (see comment above).

SPA 1A

- It was suggested that the retrospective analysis be left out of the SAR.
- Will figures be reproduced in color? Some.
    - Figure 13.
    - Figure 9 – cross hatch.
- Put TAC on Figure 2.
- Take out "26 November 2007".

SPA 1B

- Include correct table number. Upper Bay and Mid Bay should be switched.
- Put TAC on Figure 9.
- Timeframe is only October.

SPA 3

- Paragraph on page 15 is long; delete after "These deeper areas."
- Get rid of Figure 20.

SPA 4

- Figure 27 may be a problem.
- It is unclear why some figures include TACs and some do not.
- Shell heights are a nice visual.

SPA 6

- Is it necessary to go to sub-area detail?
- Are SPAs 6A, B, and C managed separately? Industry had a recommendation that there was some quota left after the closure.
- Figure 38 on same line with figures 36 and 7.

Sources of Uncertainty

- What will meat weight do next year?
- Use a single growth model rather than one that changes over time.

CLOSING REMARKS

It was suggested by participants that additional work was needed on decision criteria for next year, as well as on decision-rules.

The Chair thanked everyone for participating in this year's Bay of Fundy scallop assessment.

REFERENCES

Smith, S.J., S. Rowe, and M.J. Lundy. 2007. Scallop Production Areas in the Bay of Fundy: Stock Status for 2006 and Forecast for 2007. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/005.

Smith, S.J., M.J. Lundy, D. Roddick, D. Pezzack, and C. Frail. 2003. Scallop Production Areas in the Bay of Fundy and Scallop Fishing Area 29 in 2002: Stock Status and Forecast. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/010.

APPENDICES

Appendix 1. List of Participants

Assessment of Bay of Fundy Scallop
Maritimes Region Science Advisory Process

Baffin Boardroom, Bedford Institute of Oceanography
5 December 2007

ATTENDEES

NAME	AFFILIATION
Brooks, John	St. Mary's First Nation
Butler, Maureen	DFO Maritimes / FAM
Choi, Jae	DFO Maritimes / PED
Fry, Joy	Atlantic Herring Co-op
Greening, Linde	NS Fisheries and Aquaculture
Hazelton, Reg	Full Bay Scallop Association (FBSA)
Jellett, Joanne	APCFNC Secretariat
Johnston, Marc	NB Dept. of Fisheries
Kaye, Terry	Full Bay Scallop Association (FBSA)
Lewis, Bert	Eskasoni Fish & Wildlife Commission (EFWC)
Lundy, Mark	DFO Maritimes / PED
Robarts, Tom	Upper Bay Scallop Fishermen's Association
Rowe, Sherrylynn	DFO Maritimes / PED
Smith, Stephen	DFO Maritimes / PED
Stewart, Dick	Atlantic Herring Co-op
Sweeney, Anne	DFO Maritimes / FAM
Tremblay, John	DFO Maritimes / PED
Worcester, Tana (Chair)	DFO Maritimes / CSA

Appendix 2. Terms of Reference

Assessment of Bay of Fundy Scallop
Maritimes Region Science Advisory Process

Baffin Boardroom, Bedford Institute of Oceanography
5 – 6 December 2007[1]

TERMS OF REFERENCE

Context

In support of the fishery for scallop in the Bay of Fundy (SPAs 1, 3, 4, 5 and 6), DFO Maritimes Fisheries and Aquaculture Management has asked Science for an assessment of resource status and the consequences of various harvest levels for the coming fishing season. The current meeting is a scientific review of the assessment and projections undertaken in support of the 2008 fishery.

Objectives

For each of SPAs 1, 3, 4, 5 and 6:

- Assess the status of scallop stocks by SPA, taking into account available commercial and survey information. In addition, the assessment model used in CSAS Research Document 2003/10 should be applied for SPAs 1A and 4.
- Evaluate bycatch of non-scallop species during the 2007 fishery.
- Evaluate the consequences of different harvest levels during the 2008 fishery on stock abundance and exploitation rate by SPA. For SPA 1B, these consequences should be provided for subareas SFA 28C, 28D, and the rest of SPA 1B (SFA 28B minus SPA 6).

Outputs

CSAS Science Advisory Report (separate section of report for each SPA)
CSAS Proceedings
CSAS Research Document

Participation

DFO Science
DFO Fisheries and Aquaculture Management
Aboriginal communities / organizations
Provincial (NS and NB) governments
Industry

[1] Second day of meeting not required, thus became a one-day meeting (5 December 2007).

Appendix 3. Agenda

Assessment of Bay of Fundy Scallop
Maritimes Region Science Advisory Process

Baffin Boardroom, Bedford Institute of Oceanography
5 – 6 December 2007[2]

DRAFT AGENDA

5 December 2007 – Wednesday

09:00-09:10 Introduction

09:10-10:00 Review of SPA 4 analyses

10:00-10:30 Break

10:30-11:00 Review of SPA 4 analyses (cont'd)

11:00-12:00 Review of SPA 1 analyses

12:00-13:30 Lunch

13:30-14:00 Review of SPA 1 analyses (cont'd)

14:00-15:30 Review of SPA 3 analyses

15:00-15:30 Break

15:30-16:30 Review of SPA 6 analyses

16:30-17:00 Review of SPA 5 analyses

6 December 2007 – Thursday

09:00-09:15 Synopsis of previous day's discussion

09:15-10:00: Review of SAR

10:00-10:30: Break

10:30-12:00: Review of SAR

12:00 Adjournment

[2] Second day of meeting not required, thus became a one-day meeting (5 December 2007).